Assignment-2- Solution

(1) Given

$m = 700\ kg$

$S = 12.472$

$V_\infty = 40\ m/s$

$C_{L\,min} = ?$

Using $L = W = \frac{1}{2}\rho V^2 S C_L$

$700 \times 9.81 = \frac{1}{2} \times 1.2256 \times (40)^2 \times 12.47 \times C_L$

$C_L = 0.56144$

$$\boxed{C_{L\,min} = 0.56144}$$

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(2) $C_{m_\alpha} = C_{L_\alpha}\left[\bar{x} - \bar{x}_{ac}\right]$

$= C_{L_\alpha}\left[\frac{1}{4} - \frac{1}{4}\right]$

$\bar{x} = \frac{1}{4}$

$\bar{x}_{ac} = \frac{1}{4}$

$$\boxed{C_{m_\alpha} = 0}$$

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(3) For symmetrical Airfoil the mean camber line coincide with chord line so the distance between them always will be zero.

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(4) At aero-dynamic centre $\boxed{\frac{dC_m}{d\alpha} = 0}$ so the pitching moment co-efficient is independent of angle of attack.

(5) Given

$$C_m = -0.15 + 0.0315\alpha$$

at trim condition -

$$C_m = 0$$

$$0 = -0.15 + 0.0315\,\alpha_{trim}$$

$$\alpha_{trim} = \frac{0.15}{0.0315}$$

$$\boxed{\alpha_{trim} = 4.761^\circ}$$

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(6) By increasing or decreasing the free stream velocity the Aerodynamic centre will not change. So in this case the difference between the location of Aerodynamic centre in both cases will be zero.

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(7) Given $\Rightarrow$ $AR = 10$, $S = 10$

$$AR = \frac{b^2}{S} \Rightarrow b = \sqrt{AR \times S} = \sqrt{10 \times 10}$$

$$b = 10\,m$$

$$AR = \frac{b}{\bar{c}} \Rightarrow \bar{c} = \frac{b}{AR} = \frac{10}{10}$$

$$\boxed{\bar{c} = 1}$$

for rectangular wing $C_r = C_t = \bar{c}$ (C_t: tip chord, C_r: root chord, $\bar{c}$: mean aerodynamic chord)

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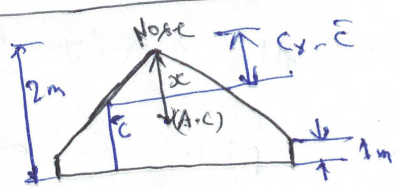
(8) Given $\Rightarrow$ $\lambda = C_t/C_r = 0.5$ — (i)

$C_t = 1\,m$, from (i) $\Rightarrow C_r = \frac{1}{0.5} = 2\,m$



Using

$$\bar{C} = \frac{2}{3} C_r \left[\frac{1+\lambda+\lambda^2}{1+\lambda}\right] = \frac{2}{3} \times 2 \left[\frac{1+0.5+0.5^2}{1+0.5}\right] \Rightarrow \boxed{\bar{C} = 1.5555\,m}$$

$C_r - \bar{C} = 2 - 1.5555 = 0.4444\,m \Rightarrow$ The distance between M.A.C and Nose

$$x = C_r - \bar{C} + \frac{\bar{C}}{4} = 0.4444 + \frac{1.5555}{4}$$

$$\boxed{x = 0.8333}$$